Sample Question Paper - 24
Chemistry (043)
Class- XII, Session: 2021-22
TERM II

Time allowed : 2 hours ***Maximum marks : 35***

General Instructions :

Read the following instructions carefully.

1. *There are 12 questions in this question paper with internal choice.*
2. *SECTION A - Q. No. 1 to 3 are very short answer questions carrying 2 marks each.*
3. *SECTION B - Q. No. 4 to 11 are short answer questions carrying 3 marks each.*
4. *SECTION C - Q. No. 12 is case based question carrying 5 marks.*
5. *All questions are compulsory.*
6. *Use of log tables and calculators is not allowed.*

Section - A

1. Explain preparation of the following (any 2):

(a) Aldehyde by dehydrogenation of alcohol.

(b) Ketones by dehydrogenation of alcohol.

(c) Carboxylic acids by oxidation of primary alcohols. **[1×2=2]**

2. Following reactions can occur at cathode during the electrolysis of aqueous silver nitrate solution using Pt electrodes: **[2]** AI

Ag^+ (aq) + e^- → Ag (s); E° = 0.80 V

H^+ (aq) + e^- → 1/2 H_2 (g); E° = 0.00 V.

On the basis of their standard electrode potential values, which reaction is feasible at cathode and why?

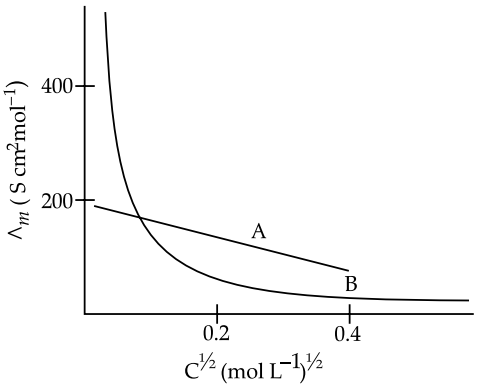
3. Explain the preparation of carboxylic acid from acyl halides and anhydrides. **[2]**

Section - B

4. **(a)** Why is Cr^{+2} is reducing agent and Mn^{+3} is oxidizing agent while both have $3d^4$ configuration ? **[2+1]**

(b) Write the electron configuration of elements with atomic numbers 91 and 109.

5. The following curve is obtained when molar conductivity (Λ_m) is plotted against the square root of concentration, $C^{1/2}$ for two electrolytes A and B: **[1×3=3]**



(a) How do you account for the increase in the molar conductivity of the electrolyte A on dilution ?

(b) As seen from the graph, the value of limiting molar conductivity (Λ°_m) for electrolyte B cannot be obtained graphically. How can this value be obtained ?

(c) Define limiting molar conductivity.

6. **(a)** Write any two characteristics of chemisorption. **[1+2]**

(b) Explain multi-molecular and macro-molecular colloids.

7. **(a)** Explain Gabriel Phthalimide synthesis with example. **[2+1]**

(b) Give the IUPAC names of following:

(i) *m*-$BrC_6H_4NH_2$

(ii) $CH_3NHCH(CH_3)_2$

OR

(a) How will you convert benzanamide to toluene? **[1+2]**

(b) Ketones are less reactive than aldehydes. Why?

8. **(a)** **(i)** Transition metals form alloys. Why? **[2+1]**

(ii) Chromium is typically hard metal but mercury is liquid. Why?

(b) Based on the data, arrange Fe^{2+}, Mn^{2+} and Cr^{2+} in the increasing order of stability of +2 oxidation state.

$E^\circ_{Cr^{3+}/Cr^{2+}} = -0.4$ V

$E^\circ_{Mn^{3+}/Mn^{2+}} = +1.5$ V

$E^\circ_{Fe^{3+}/Fe^{2+}} = +0.8$ V

OR

Give reasons:

(a) E° value for Mn^{3+}/Mn^{2+} is much more positive than that for Fe^{3+}/Fe^{2+}. **[1×3=3]**

(b) Iron has higher enthalpy of atomisation than that of copper.

(c) Sc^{3+} is colourless in aqueous solution whereas Ti^{3+} is coloured.

9. Following ions are given: Cr^{2+}, Cu^{2+}, Cu^{+}, Fe^{+2}, Fe^{3+}, Mn^{+3}

Identify the ion which is

(a) A strong reducing agent **[1×3=3]**

(b) Unstable in aqueous solutions

(c) A strong oxidizing agent.

Give reasons to support your answer.

OR

(a) What is the IUPAC name of the complex $[Ni(NH_3)_6]Cl_2$? **[1×3=3]**

(b) What is meant by chelate effect?

(c) Which of the following is more stable complex and why?

$[Co(NH_3)_6]^{3+}$ and $[Co(en)_3]^{3+}$.

10. Predict the products formed when cyclohexane carbaldehyde reacts with following reagents. **[1×3=3]**

(a) PhMgBr and then H_3O^+

(b) Tollens' reagent

(c) Semicarbazide in weak acidic medium.

11. **(a)** Give a chemical test to distinguish between N-methylethanamine and N,N-dimethyl ethanamine.

(b) Write the reaction for catalytic reduction of nitrobenzene followed by reaction of product so formed with bromine water.

(c) Out of butan-1-ol and butan-1-amine, which will be more soluble in water and why? **[1×3=3]**

OR

Arrange the following in increasing order of specified property: **[1×3=3]**

(a) Aniline, ethanamine, 2-ethylethanamine (solubility in water)

(b) Ethanoic acid, ethanamine, ethanol (boiling point)

(c) Methanamine, N, N- dimethylmethanamine and N- methylmethanamine (basic strength in aqueous phase)

Section - C

12. **Read the passage given below and answer the following questions:**

The rate of the reaction is proportional to the concentration of the reactant. Hydrogenation of ethene results in the formation of ethane. The rate constant, k for the reaction was found to be $2.5 \times 10^{-15} s^{-1}$. The concentration of the reactant reduces to one-third of the initial concentration in 5 minutes.

(a) What is the order of the reaction ?

(b) Depict the rate law equation for the hydrogenation of ethene.

(c) Find the half-life of the reaction.

(d) What will be the rate constant of the reaction after 5 minutes? AI

OR

(d) Find the slope of the curve in the reaction. **[1+1+1+2]**

❑❑❑

Solution

CHEMISTRY - 043

Class 12 - Chemistry

Section - A

1. **(a)** Preparation of aldehyde by dehydrogenation of alcohols:

$$\underset{1^\circ \text{ Alcohol}}{R-CH_2-OH} \xrightarrow[573K]{Cu} \underset{\text{Aldehyde}}{RCHO} + H_2$$ **[1]**

(b) Preparation of ketone by dehydrogenation of alcohols

$$\underset{2^\circ \text{ Alcohol}}{\begin{matrix}R\\R\end{matrix}\!\!>\!CH-OH} \xrightarrow[573\ K]{Cu} \underset{\text{Ketone}}{\begin{matrix}R\\R'\end{matrix}\!\!>\!C=O} + H_2O$$ **[1]**

(c) By oxidation of primary alcohols and aldehydes:

$$\underset{1^\circ \text{ Alcohol}}{R-CH_2-OH} \xrightarrow[(ii)\ H_3O^+]{(i)\ Alc.KMnO_4} \underset{\text{Carboxylic acid}}{R-COOH}$$

$$\underset{\text{Aldehyde}}{R-CHO} + [O] \xrightarrow{K_2Cr_2O_7/H_2SO_4} \underset{\text{Carboxylic acid}}{R-COOH}$$

(any two) **[1]**

2. The reaction $Ag^+(aq) + e^- \rightarrow Ag(s)$ will be feasible at cathode because it has higher reduction potential.

As reaction with higher value of standard electrode potential occurs at cathode, Ag gets reduced. So, the reaction occurring at cathode $Ag^+(aq) + e^- \rightarrow Ag(s)$ **[2]**

Commonly Made Error

- Sometimes students are confused between standard electrode potential order and oxidation/reduction, So, they misinterpret cathode for oxidation and anode for reduction and give wrong order.

Answering Tip

- Metal with highly reduction potential occurs at cathode. At cathode, reduction occurs.

3. When acid chloride is hydrolysed with water then carboxylic acid is produced and it is more readily hydrolysed with aqueous base and gives corresponding carboxylic ions which on further acidification gives the carboxylic acid.

$$RCOCl \xrightarrow{H_2O} RCOOH + Cl^-$$

$$RCOCl \xrightarrow{OH^-/H_2O} RCOO^- + Cl^- \xrightarrow{H_3O^+} RCOOH$$

Anhydrides are hydrolysed with water to form carboxylic acid.

$$\underset{\text{Benzoic anhydride}}{(C_6H_5CO)_2O} \xrightarrow{H_2O} \underset{\text{Benzoic acid}}{2C_6H_5COOH}$$ **[2]**

Section - B

4. **(a)** E° value for Cr^{3+}/Cr^{2+} is negative (–0.41 V) whereas, E° values for Mn^{3+}/Mn^{2+} is positive (+1.57 V). Hence, Cr^{2+} ion can easily undergo oxidation to give Cr^{3+} ion and, therefore, act as strong reducing agent whereas, Mn^{3+} can easily undergo reduction to give Mn^{2+} and hence act as an oxidizing agent. **[2]**

(b)

Atomic number	Electronic configuration
91	$[Rn]^{86}\ 5f^2\ 6d^1\ 7s^2$
109	$[Rn]^{86}\ 5f^{14}\ 6d^7\ 7s^2$

[1]

5. **(a)** As seen from the graph, electrolyte A is a strong electrolyte which is completely ionised in solution. With dilution, the ions are far apart from each other and hence the molar conductivity increases. **[1]**

(b) To determine the value of limiting molar conductivity for electrolyte B, indirect method based upon Kohlrausch's law of independent migration of ions is used. **[1]**

(c) When concentration approaches zero, the molar conductivity is known as limiting molar conductivity. **[1]**

6. **(a)** **(i)** Chemisorption is a specific process that only occurs if there is a chemical bond between adsorbent and adsorbate.

(ii) Chemisorption is an endothermic reaction, so it is inversely proportional to temperature.

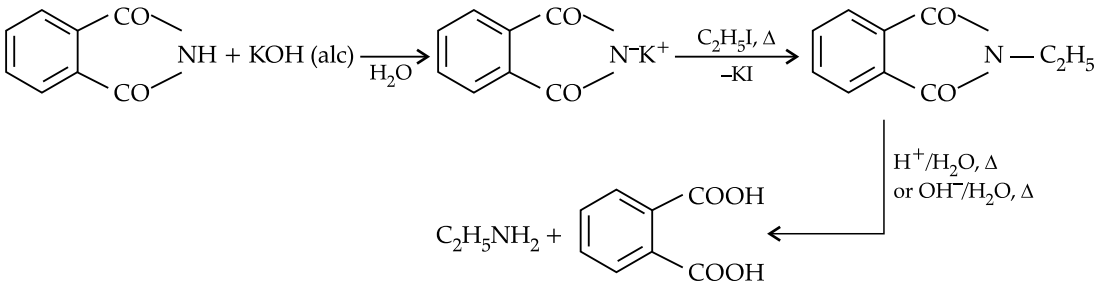
[1/2+1/2= 1]

(b)

Multi-molecular colloid	Macro-molecular colloid
The colloidal particles in multi-molecular colloids are an assemblage of atoms on tiny molecules having a diameter of less than 1 nm. Van der Waals forces of attraction hold the molecules aggregate together.	Colloidal particles in macro-molecular colloids are big molecules with colloidal dimensions. The molecular mass off these particles is extremely high. Sol is created when these particles are dissolved in a liquid.
Gold sol and sulphur sol are two examples of such colloids.	For example, starch, nylon, cellulose, *etc*.
They are lyophobic in nature.	They are usually lyophilic in nature.

[2]

7. **(a)** **Gabriel phthalimide synthesis:** It is a method of preparation of pure aliphatic and aralkyl primary amines. Phthalimide on treatment with ethanolic KOH gives potassium phathalimide which on heating with a suitable alkyl or aralkyl halides gives N-substituted phthalimides, which on hydrolysis with dil. HCl or with alkali give primary amines.



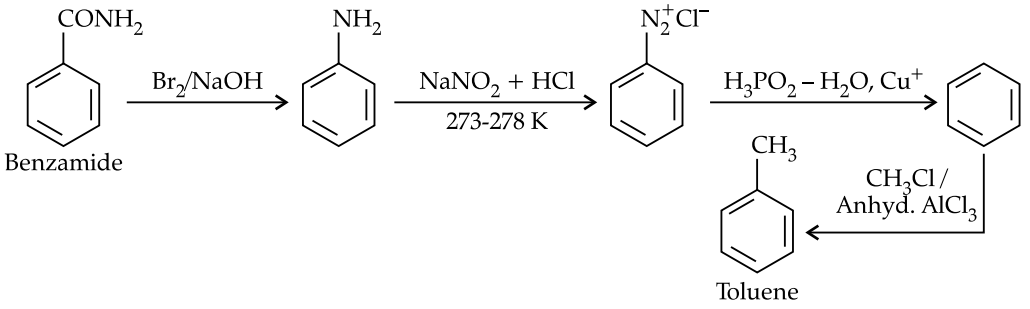
[2]

(b) **(i)** 3-Bromobenzenamine or 3-bromoaniline **[1]**

(ii) N-Methylpropan-2-amine **[1]**

OR

(a)



[1]

(b) Ketones are less reactive than aldehydes due to following reasons:

(i) Electron releasing effect

In ketones, the carbonyl carbon is attached to alkyl groups which are electron releasing in nature. These alkyl groups push electrons towards carbonyl carbon and therefore, decrease the magnitude of positive charge on it and make it less reactive towards nucleophilic attack.

(ii) Steric effect

In ketones, the presence of two bulky alkyl groups also hinders the approach of the nucleophile to attack the carbonyl carbon. **[2]**

8. **(a) (i)** Due to the almost similar atomic sizes of elements, atoms can easily occupy the position in the crystal lattice of the other atom of another element (metal). Thus, easily formation of alloys is the property of transition metals. **[1]**

(ii) Due to the presence of large number of unpaired electrons, metal-metal interaction is strong whereas mercury does not have unpaired electrons and forms weak metallic bonds. **[1]**

(b) Higher the reduction potential, higher will be the ability to reduce itself to attain +2 oxidation state.

Thus, order of stability of +2 oxidation state.

$Cr^{2+} < Fe^{2+} < Mn^{2+}$

OR

(a) Because Mn^{2+} is more stable than Mn^{3+} due to half-filled d^5 configuration whereas Fe^{2+} becomes unstable after gaining an electron to its half-filled orbital. **[1]**

(b) Due to presence of higher number of unpaired electrons in iron, they have stronger metallic bonding. Hence, the enthalpy of atomisation is more of iron than that of copper. **[1]**

(c) Sc^{3+} ($3d^0$) is colourless as it does not contain unpaired electrons to undergo *d-d* transition while $Ti^{3+}(3d^1)$ is coloured as it contains unpaired electrons to undergo *d-d* transition by absorbing light from visible region and radiate complementary colour. **[1]**

9. **(a)** Cr^{2+} is strong reducing agent because its electronic configuration changes from d^4 to d^5 and have half-filled t_{2g} level. **[1]**

(b) Cu^+ in aqueous medium is required to remove one electron from Cu^+ to Cu^{+2}, high hydration energy of Cu^{+2} compensates for it. Therefore, Cu^+ ion in an aqueous solution is unstable.

$2Cu^+ \rightarrow Cu^{+2}(eq) + Cu(s)$ **[1]**

(c) Mn^{3+} is strong oxidising agent because configuration changes from d^4 to d^5 when Mn^{3+} is reduced to Mn^{+2}, and d^5 (half-filled) configuration is extra stable. **[1]**

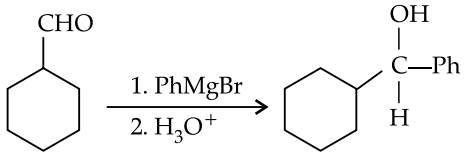
OR

(a) Hexaamminenickel (II) Chloride. **[1]**

(b) Formation of stable complex with a polydentate ligand due to stronger bonding is known as chelate effect. **[1]**

(c) $[Co(en)_3]^{3+}$: Because (en) is a chelating ligand/bidentate ligand. **[1]**

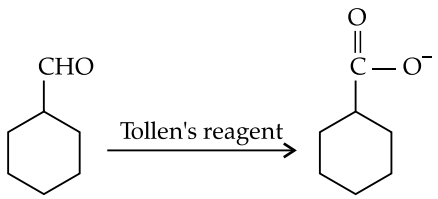
10. **(a)**



Cyclohexane carbaldehyde — 1-Cyclohexyl -1-phenylmethanol

[1]

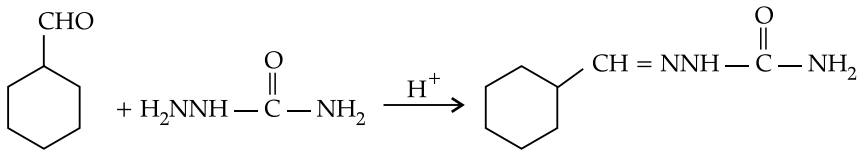
(b)



Cyclohexane carbaldehyde — Cyclohexane carboxylate ion

[1]

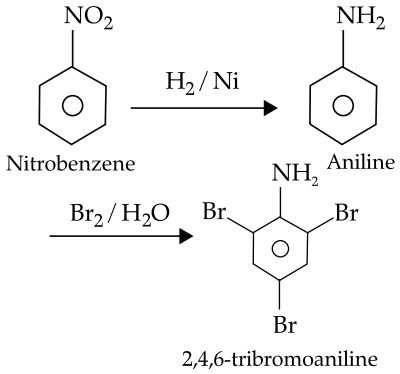
(c)



Cyclohexane carbaldehyde — Semicarbazide — Cyclohexane carbaldehyde semicarbazone **[1]**

11. **(a)** N-methylethanamine is a secondary amine. When it reacts with benzene sulphonyl chloride, it forms N- Ethyl -N methyl sulphonamide, where as N, N-dimethyl ethanamine so, is a tertiary amine so, it does not react with benzene-sulphonyl chloride. **[1]**

(b)



2,4,6-tribromoaniline **[1]**

(c) Butan-1-ol

Alcohol forms stronger hydrogen bonds with water than formed by amine due to higher electronegativity of oxygen in alcohol than nitrogen in amine. **[1]**

OR

(i) Aniline < N-ethylethanamine < Ethanamine **[1]**

Ethanamine form intermolecular H-bonds with water. N-ethyl ethanamine has bulky alkyl group that form weak H-bonds. But aniline does not form H-bonds due to hydrophobic – C_6H_5 group attached to amine.

(ii) Ethanamine < ethanol < ethanoic acid **[1]**

In liquid state, two ethanoic acid molecules are held together by two H-bonds to form dimer. Thus, bigger size of dimer has great Van Der Waals forces. So, ethanoic acid has higher boiling point than ethanol. Also, alcohols have higher boiling point than amines.

(iii) N, N dimethylmethanamine < methanamine < N-methylmethanamine **[1]**

Order of basic strength of amines in aqueous solution depends upon +I effect of alkyl groups, solution effect and steric hindrance. Greater the size of ion, lesser is the solution.

Section - C

12. **(a)** Since, the rate of the reaction is proportional to the concentration of the reactant *i.e.*, ethene so, it is first order reaction. **[1]**

(b) $C_2H_4 + H_2 \xrightarrow{\text{Catalyst}} C_2H_6$

Ethene — Ethane

Here, hydrogen is taken in excess so the reaction is first order reaction.

Rate law equation, Rate = $k\,[C_2H_4]$ **[1]**

(c) For first order reaction,

$$t_{1/2} = \frac{0.693}{k}$$

$$= \frac{0.693}{2.5 \times 10^{-15}\,s^{-1}}$$

$$= 2.772 \times 10^{14}\,s$$ **[1]**

(d) Given, $t = 5$ min

$$\frac{[R]_o}{[R]} = 3$$

For first order reaction,

$$k = \frac{2.303}{t}\log\frac{[R]_o}{[R]}$$

$$= \frac{2.303}{5}\log 3$$

$$= \frac{2.303}{5} \times 0.4771$$

$$= 0.2197\,min^{-1}$$ **[2]**

OR

Since, $k = 1/t \ln [R_o]/[R]$

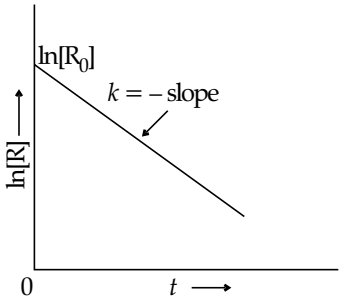
$kt = \ln[R_o] - \ln [R]$

$\ln [R] = -kt + \ln [R_o]$

$y = mx + c$

So, $m = -k$

Slope $= -k$



[2]